RADMON Studies

SiPIN Diode

- Device installed:

✓ On-board sensors description:

Function	Type	Device	Operating Range	Sensitivity / Resolution
Total Dose sensor	RadFET	REM 250nm	a few 10^{-1} Gy to more than 10^4 Gy	~20 mV/Gy (initial)
1MeV n eq. Fluence sensor (wide dynamic range)	p-i-n diode	BPW34S	~2×10^{12} cm^{-2} to ~4×10^{14} cm^{-2} (linear)	~1×10^{10} cm^{-2}/mV
1MeV n eq. Fluence sensor (high-sensitivity)	p-i-n diode	LBSD Si-1	10^{10} cm^{-2} to ~2×10^{12} cm^{-2} (linear)	~2×10^{8} cm^{-2}/mV
Temperature sensor	Thermistor	NTC 10kΩ	-55 ºC to 125 ºC	0.1 ºC
Line check	Resistor	1kΩ resistor	---	---

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SiPIN Calibration

- From Ravotti Thesis:
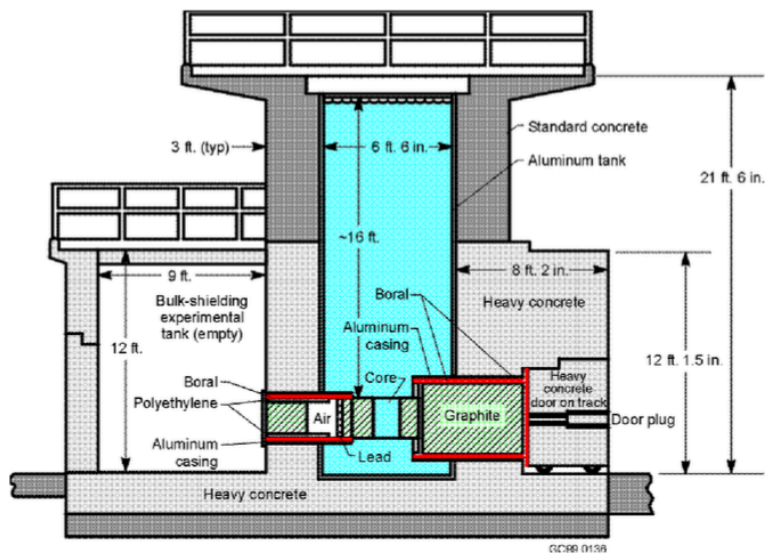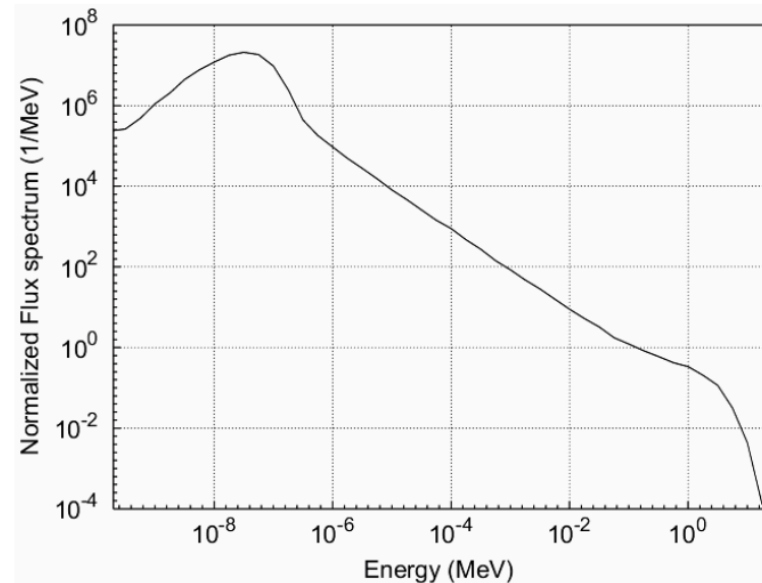
Figure 4.4: TRIGA Mark II reactor at JSI. (a) Cross-section of the reactor facility. (b) Normalized neutron flux spectrum at 250 kW. The normalization has been done in a way that $\int_{100keV}^{20MeV} \Phi(E)dE = 1$, where $\Phi(E)$ is the neutron flux.
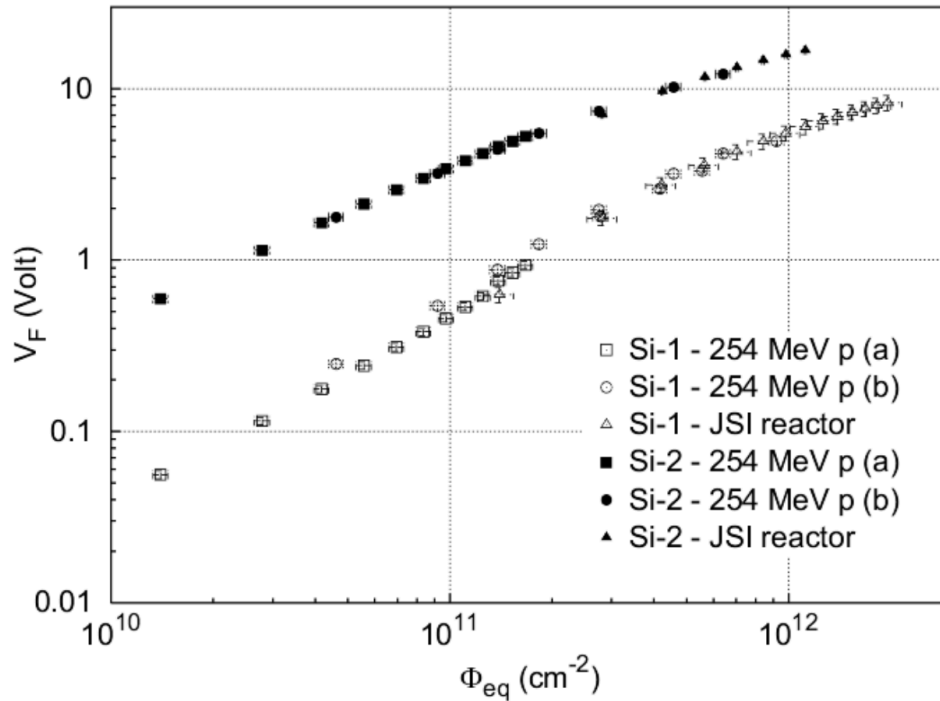
SiPIN Calibration

- From Ravotti Thesis:

Figure 7.18: Radiation response of LBSD diodes. The diode's forward voltage at 25 mA is plotted versus the Φ_{eq}. The width of the readout current pulse was of 50 ms. The experimental data taken in the 254 MeV beam of the PIF facility at PSI have been recorded at different proton rates: (a) $1 \times 10^8 cm^{-2} \cdot s^{-1}$, (b) $2.5 \times 10^8 cm^{-2} \cdot s^{-1}$.

$\Delta V_F = ck\Phi$
$\quad\quad = c\Phi_{eq}$

Inverse Slope:
$1/c = 1.6 \times 10^8$ cm^{-2}/mV

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Radmons and SiPMs RUN-15

- In May 6 SiPMs were installed:
  - Powered by MPOD System
  - 4 located at 90cm from IP, 90 degrees from beam pipe; 2 inside a Gd box.
  - 2 located at base of CMN, 180cm from IP and 15 Degrees below beam line.
  - ~9 Day period when bias was not applied, approximately 23-May to 2-June

- RadMons mounted with both sets of SiPMs
- Additional RadMon mounted on ^{3}He tube

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P-i-N Diode analysis

- Look at only voltage measurements when PHENIX CM is energized:

- Initial (un-irradiated) forward voltage: Average voltage for the period 0000-0130 on 2-May-2015

- Temperature correct to 22 ^{o}C using a temperature correction of T_c = -0.9 mV/^{o}C.

  - Seems to give better correction
  - Ravotti thesis claims T_c = -1.8mV/^{o}C
  - T_c fluence dependent?
  - Re-measure temp dependence ?
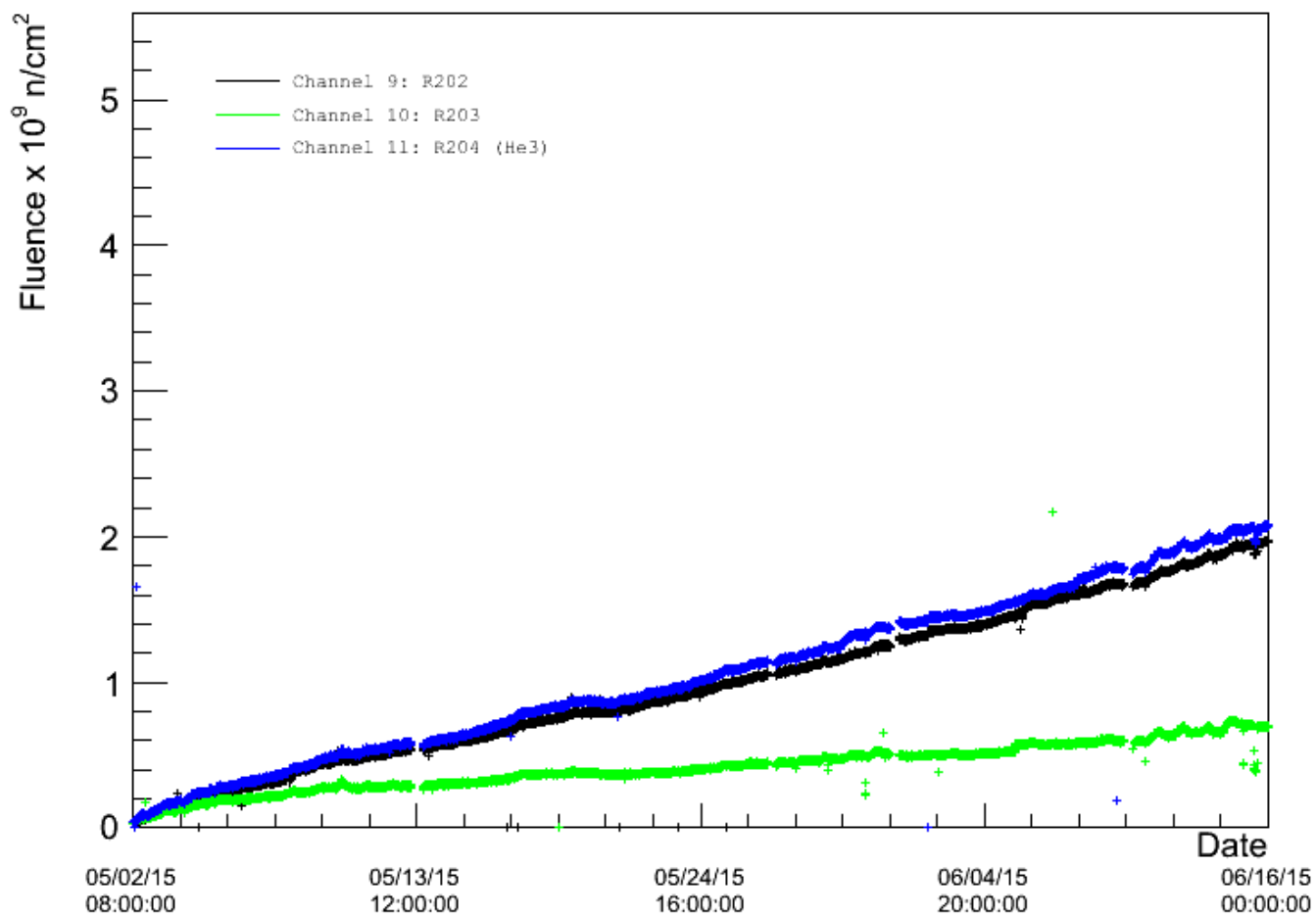 - Evidence of temperature dependence seen in radmons mounted on pole tip
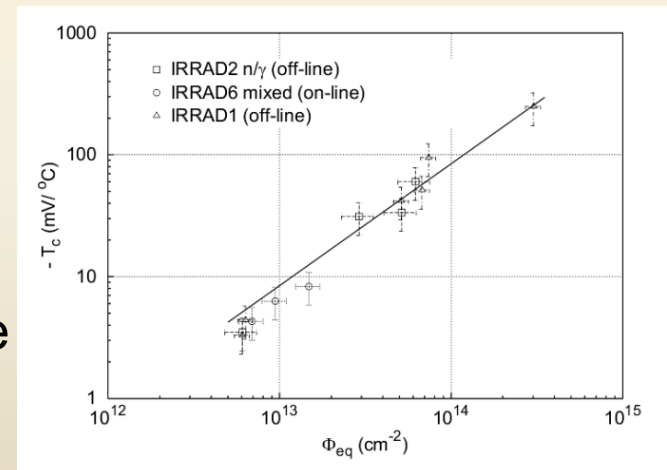
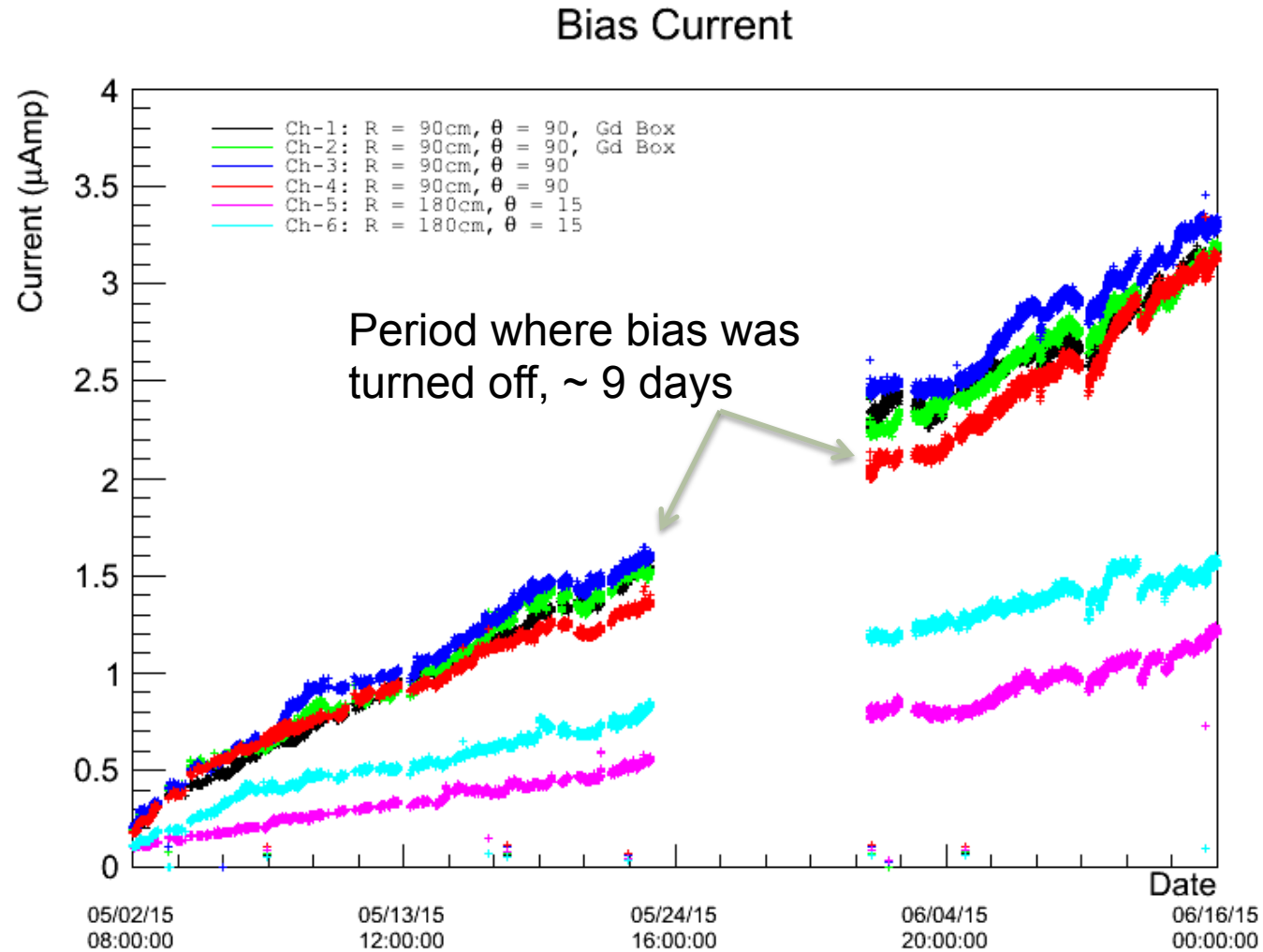BPW34F temp Dependence

P-i-N Diode Forward Voltage- Corrected
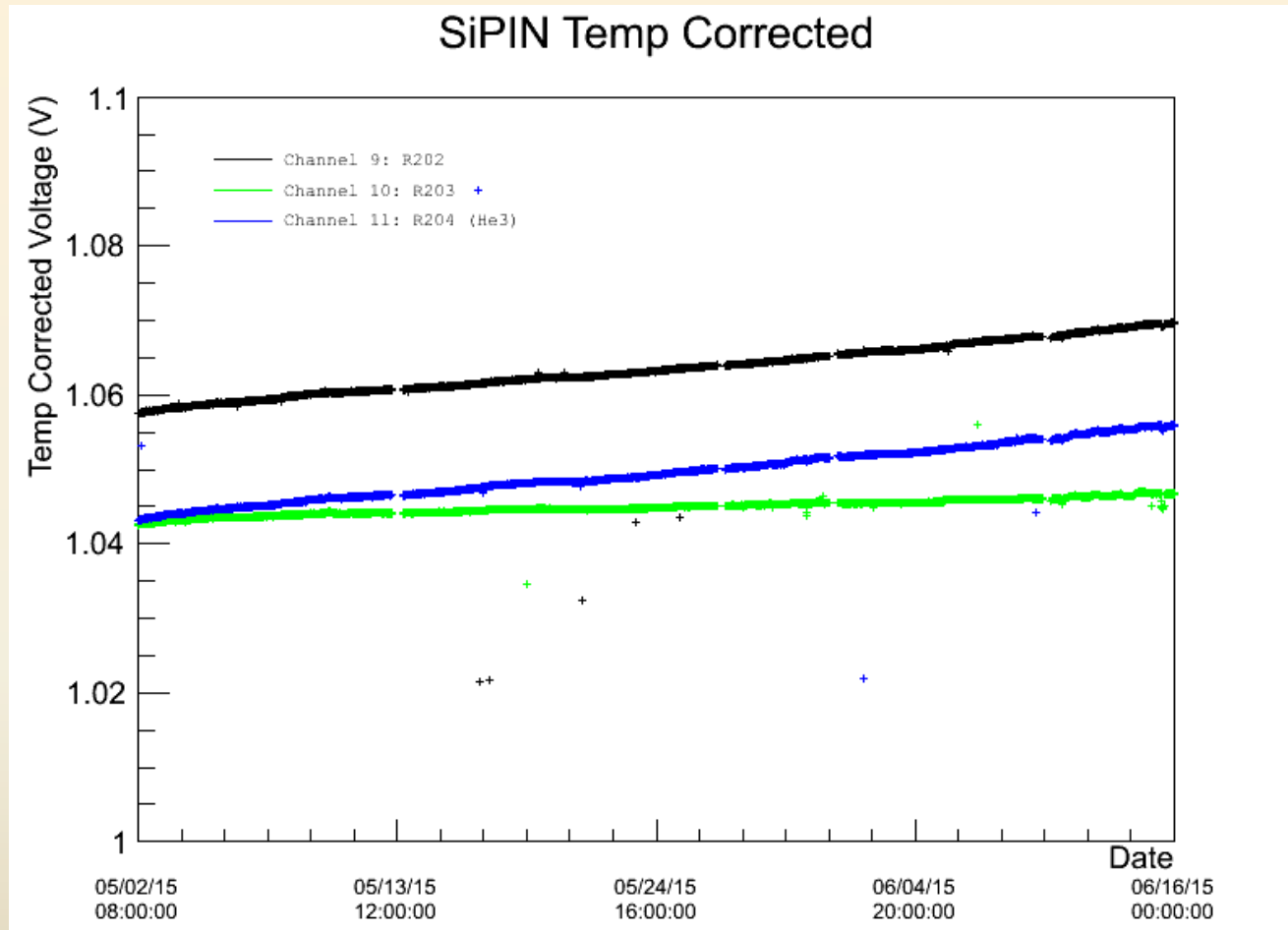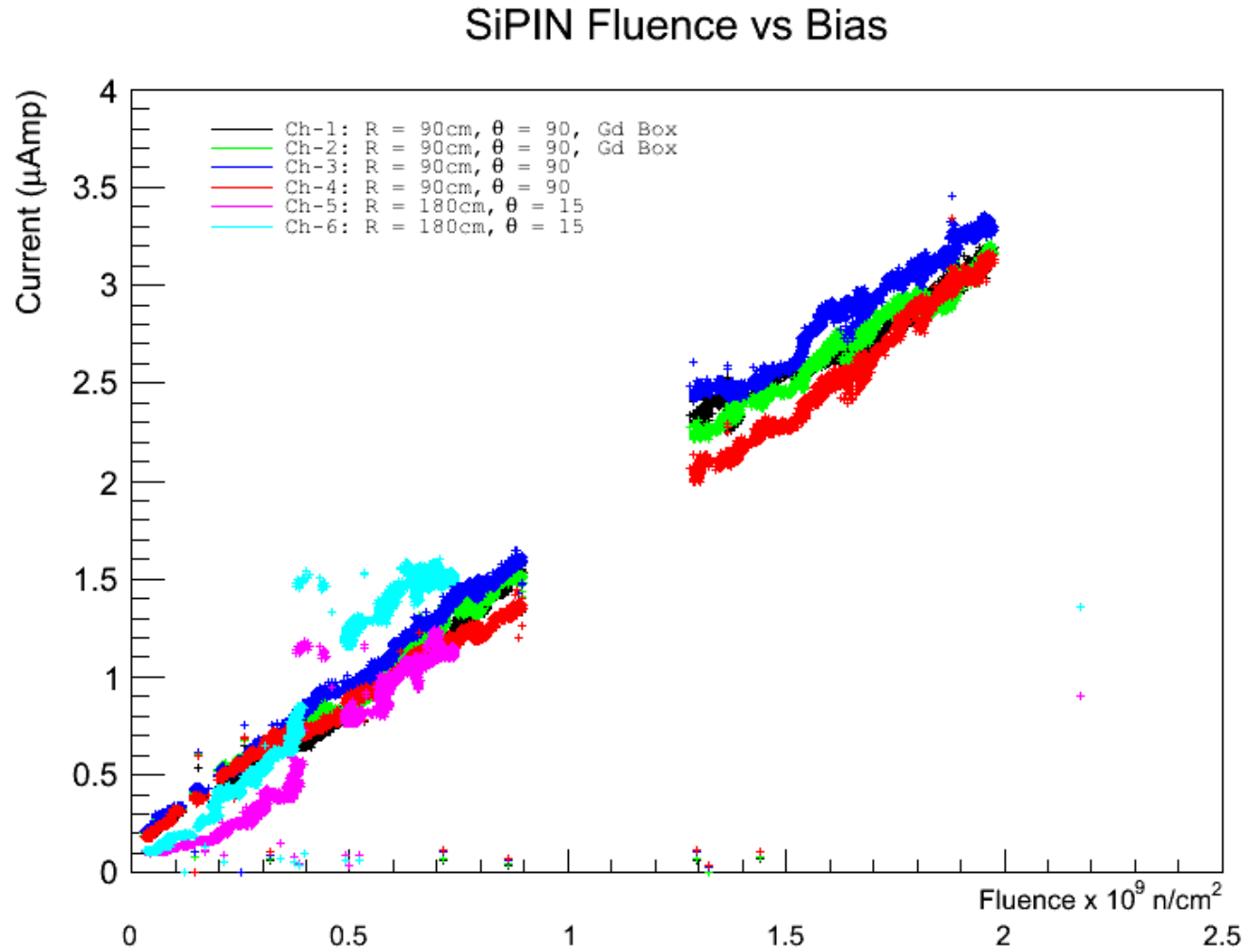
Converting to Fluence

SiPIN Fluence

Looking at the bias currents

Bias Current

Period where bias was turned off, ~ 9 days

Bias as a Function of Fluence

SiPIN Fluence vs Bias

LANL Neutron Test

- Last December, several SiPMs were irradiated at LANL
- 2 Radmons (R131 and R132) were also irradiated to 2 different fluences
- RadMons were characterized before and after being irradiated at BNL
- Using same basic conversion measured fluences are:
    - R131: 9.9×10^{10}
    - R132: 3.2×10^{10}
- Reported fluences:
    - R131: 9.7×10^{11} (E > 1.5MeV)
    - R132: 3.7×10^{11} (E > 1.5 MeV)

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